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RACCOON LAKE, MARION COUNTY, ILLINOIS

Pacific Northwest Environmental
Research Laboratory

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TECHNICAL REPORT DATA

Report on Raccoon Lake, Marion County, Illinois

Prepared June 1975

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Working Paper # 312

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Annual total phosphorus and total nitrogen loadings to the lake were collected and studied in detail to either point or non-point sources. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

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REPORT
ON
RACCOON LAKE
MARION COUNTY
ILLINOIS

EPA REGION V

WORKING PAPER No. 312

WITH THE COOPERATION OF THE

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

AND THE

ILLINOIS NATIONAL GUARD

JUNE, 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Illinois Environmental Protection Agency for professional involvement and to the Illinois National Guard for conducting the tributary sampling phase of the Survey.

Dr. Richard H. Briceland, Director of the Illinois Environmental Protection Agency; and Ronald M. Barganz, State Survey Coordinator, and John J. Forneris, Manager of Region III, Field Operations Section of the Division of Water Pollution Control, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

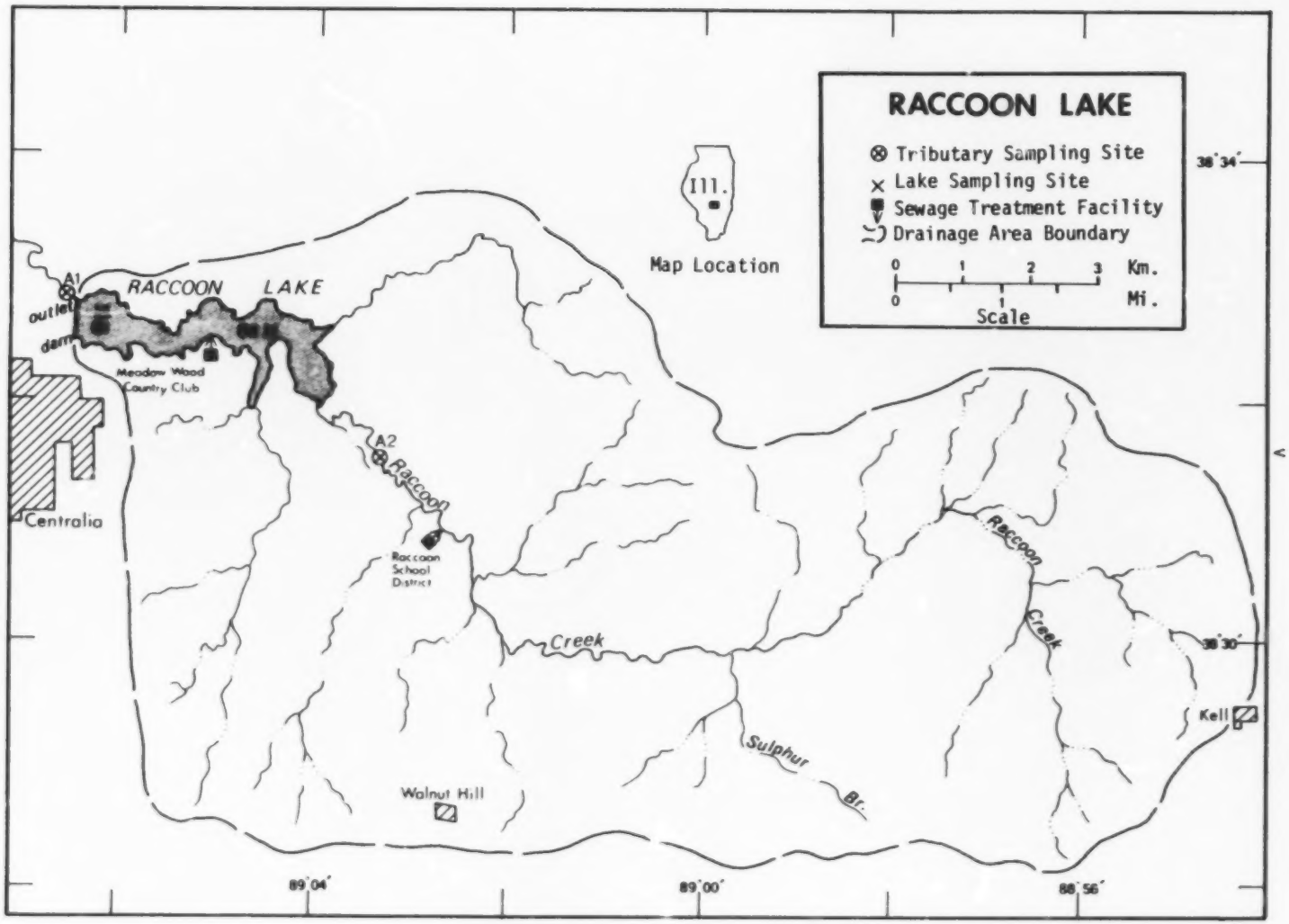
Major General Harold R. Patton, the Adjutant General of Illinois, and Project Officer Colonel Daniel L. Fane, who directed the volunteer efforts of the Illinois National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF ILLINOIS

LAKE NAME	COUNTY
Baldwin	Randolph
Bloomington	McLean
Carlyle	Bond, Clinton, Fayette
Cedar	Lake
Charleston	Coles
Coffeen	Montgomery
Crab Orchard	Jackson, Williamson
Decatur	Macon
DePue	Bureau
East Loon	Lake
Fox	Lake
Grass	Lake
Highland Silver	Madison
Holiday	LaSalle
Horseshoe	Madison
Long	Lake
Lou Yaeger	Montgomery
Marie	Lake
Old Ben Mine	Franklin
Pistakee	Lake, McHenry
Raccoon	Marion
Rend	Franklin, Jefferson
Sangchris	Christian
Shelbyville	Moultrie, Shelby
Slocum	Lake
Springfield	Sangamon
Storey	Knox
Vandalia	Fayette
Vermilion	Vermilion
Wee Ma Tuk	Fulton
Wonder	McHenry


RACCOON LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Drainage Area Boundary
0 1 2 3 Km.
0 Mi.
Scale
Ill.
Map Location
A1
outlet
dam
RACCOON LAKE
Meadow Wood Country Club
Centralia
A2
Raccoon
Raccoon School District
Creek
Raccoon
Creek
Sulphur Br.
Walnut Hill
Kell
38°34'
38°30'
89°04'
89°00'
88°56'

RACCOON LAKE

STORET NO. 1762

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Raccoon Lake is eutrophic. It ranked twelfth in overall trophic quality when the 31 Illinois lakes sampled in 1973 were compared using a combination of six parameters*. Thirteen of the lakes had less median total phosphorus, nine had less and one had the same median dissolved phosphorus, eight had less median inorganic nitrogen, 12 had less mean chlorophyll a, and 21 had greater mean Secchi disc transparency. Marked depression of dissolved oxygen with depth occurred at sampling station 1 in August, 1973.

Survey limnologists reported algae scums in August and noted the occurrence of floating and emergent rooted aquatic plants along the shorelines.

B. Rate-Limiting Nutrient:

The algal assay results are not considered indicative of conditions in the lake at the time the sample was collected due to significant changes in the orthophosphorus in the sample between the time of collection (05/11/73) and the beginning of the assay.

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* See Appendix A.

The lake data indicate phosphorus limitation in May and August but nitrogen limitation in October.

C. Nutrient Controllability:

1. Point sources--The phosphorus contribution of point sources amounted to 2.5% of the total input to Raccoon Lake during the sampling year. These sources included the Meadow Wood Country Club (1.5%) and the Raccoon School District (0.3%). Septic tanks adjacent to the lake were estimated to have contributed 0.7% of the total.

The present loading rate of 1.17 $g/m^2/yr$ is over two times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic rate (see page 12). For this reason, all phosphorus inputs to the lake should be minimized to the greatest practicable extent to slow the eutrophication of this water body.

2. Non-point sources--Over 97% of the total phosphorus input to Raccoon Lake was contributed by non-point sources during the sampling year. After accounting for the Raccoon School point-source load, Raccoon Creek contributed 70.9% of the total. Ungaged tributaries were estimated to have contributed 25.1% of the total annual phosphorus input.

The phosphorus export rate of Raccoon Creek was a relatively low 36 $kg/km^2/yr$ and compares well with the export rate of Hickory Creek (25 $kg/km^2/yr$), an unimpacted tributary of nearby Carlyle Reservoir*.

* Working Paper No. 297.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 3.93 kilometers^2.
2. Mean depth: 1.2 meters.
3. Maximum depth: >3.7 meters.
4. Volume: 4.949×10^6 m^3.
5. Mean hydraulic retention time: 72 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Raccoon Creek	90.1	0.6
Minor tributaries & immediate drainage -	31.9	0.2
Totals	122.0	0.8

2. Outlet -

Raccoon Creek	125.9**	0.8

C. Precipitation***:

1. Year of sampling: 124.2 centimeters.
2. Mean annual: 102.0 centimeters.

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† Table of metric conversions--Appendix B
†† Forneris, 1973.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Raccoon Lake was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the lake and from a number of depths at each station (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 3.7 meters at station 1 and 0.9 meters at station 2.

The lake sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR RACCOON LAKE
STORET CODE 1762

PARAMETER	1ST SAMPLING (5/11/73) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (8/ 8/73) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/19/73) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	17.5 - 19.2	18.7	19.0	27.5 - 28.3	27.9	27.9	16.8 - 17.9	17.3	17.3
DISS OXY (MG/L)	6.7 - 8.1	7.5	7.9	1.2 - 6.4	5.0	6.2	7.2 - 8.4	7.8	7.8
CNDCTVY (MCHOMO)	260. - 275.	269.	270.	308. - 318.	311.	308.	174. - 202.	188.	188.
PH (STAND UNITS)	7.6 - 7.7	7.6	7.6	7.1 - 7.8	7.5	7.5	7.2 - 7.6	7.4	7.4
TOT ALK (MG/L)	61. - 65.	63.	64.	60. - 73.	64.	62.	44. - 48.	45.	45.
TOT P (MG/L)	0.090 - 0.110	0.101	0.103	0.062 - 0.151	0.111	0.125	0.073 - 0.299	0.145	0.105
ORTHO P (MG/L)	0.020 - 0.036	0.027	0.025	0.012 - 0.044	0.024	0.020	0.016 - 0.026	0.019	0.017
NO2+NO3 (MG/L)	0.280 - 0.290	0.287	0.290	0.110 - 0.170	0.134	0.130	0.070 - 0.180	0.122	0.120
AMMONIA (MG/L)	0.110 - 0.230	0.175	0.180	0.110 - 0.520	0.204	0.130	0.060 - 0.140	0.100	0.100
KJEL N (MG/L)	0.800 - 1.000	0.900	0.900	1.300 - 2.000	1.740	1.800	0.800 - 1.200	1.000	1.000
INORG N (MG/L)	0.400 - 0.520	0.462	0.465	0.220 - 0.650	0.338	0.270	0.130 - 0.320	0.222	0.220
TOTAL N (MG/L)	1.080 - 1.290	1.187	1.190	1.410 - 2.120	1.874	1.930	0.960 - 1.380	1.122	1.075
CHLRPYL A (UG/L)	3.0 - 17.9	10.4	10.4	32.3 - 40.9	36.6	36.6	3.1 - 18.1	10.6	10.6
SECCHI (METERS)	0.2 - 0.3	0.3	0.3	0.3 - 0.8	0.5	0.5	0.4 - 0.5	0.4	0.4

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
05/11/73	1. Flagellates	1,933
	2. Coccoid Chrysophyta	1,294
	3. *Cryptomonas* sp.	701
	4. Centric diatoms	421
	5. *Trachelomonas* sp.	110
	Other genera	220
	Total	4,679
08/08/73	1. *Oscillatoria* sp.	16,712
	2. *Dactylococcopsis* sp.	2,381
	3. Centric diatoms	1,236
	4. Pennate diatoms	1,236
	5. *Melosira* sp	1,007
	Other genera	5,218
	Total	27,790
10/19/73	1. *Merismopedia* sp.	1,195
	2. Pennate diatoms	724
	3. *Melosira* sp.	702
	4. Centric diatoms	702
	5. *Oscillatoria* sp.	406
	Other genera	1,042
	Total	4,771

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
05/11/73	01	3.0
	02	17.9
08/08/73	01	32.3
	02	40.9
10/19/73	01	18.1
	02	3.1

C. Limiting Nutrient Study:

The algal assay results are not considered indicative of conditions in the lake at the time of sampling because of a 63% orthophosphorus loss from the time the sample was collected to the beginning of the assay.

The lake data indicate phosphorus limitation in May and August but nitrogen limitation in October (the mean inorganic nitrogen/orthophosphorus ratios were 17/1, 14/1, and 12/1, respectively).

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Illinois National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff month of March when two samples were collected. Sampling was begun in June, 1973, and was completed in May, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Illinois District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the adjusted nutrient loads, in $kg/km^2/year$, in Raccoon Creek at station A-2 and multiplying by the ZZ area in km^2.

The operator of the Raccoon School District wastewater treatment plant provided monthly effluent samples and corresponding flow data. The Meadow Wood Country Club did not participate in the sampling program, and nutrient loads were estimated at 1.134 kg P and 3.401 kg N/capita/year.

* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal* -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Raccoon Sch. District	360	sand filter	10.6	Raccoon Creek
Meadow Wood Country Club	60	ext. aer.	22.7**	Raccoon Lake

2. Known industrial - None

* Anonymous, 1972.
** Estimated at 0.3785 m^3/capita/day.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Raccoon Creek	3,245	70.9
b. Minor tributaries & immediate drainage (non-point load) -	1,150	25.1
c. Known municipal STP's -		
Raccoon Sch. District	15	0.3
Meadow Wood Country Club	70	1.5
d. Septic tanks* -	30	0.7
e. Known industrial - None	-	-
f. Direct precipitation** -	70	1.5
Total	4,580	100.0

2. Outputs -

Lake outlet - Raccoon Creek 3,270

3. Net annual P accumulation - 1,310 kg.

* Estimate based on 101 lakeshore dwellings and one park; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/ yr	% of total
a. Tributaries (non-point load) -		
Raccoon Creek	52,560	68.4
b. Minor tributaries & immediate drainage (non-point load) -	18,600	24.2
c. Known municipal STP's -		
Raccoon Sch. District	100	0.1
Meadow Wood Country Club	205	0.3
d. Septic tanks* -	1,110	1.5
e. Known industrial - None	-	-
f. Direct precipitation** -	4,245	5.5
Total	76,820	100.0

2. Outputs -

Lake outlet - Raccoon Creek 43,970

3. Net annual N accumulation - 32,850 kg.

* Estimate based on 101 lakeshore dwellings and one park; see Working Paper No. 175.
** See Working Paper No. 175.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Raccoon Creek	36	583

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" rate is the rate at which the receiving water would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m²/yr	1.17	0.33	19.5	8.4

Vollenweider loading rates for phosphorus (g/m²/yr) based on mean depth and mean hydraulic retention time of Raccoon Lake:

"Dangerous" (eutrophic rate)	0.48
"Permissible" (oligotrophic rate)	0.24

V. LITERATURE REVIEWED

Anonymous, 1972. Wastewater treatment works data book. IL Env. Prot. Agency, Springfield.

Forneris, John J., 1973. Personal communication (lake morphometry). IL Env. Prot. Agency, Springfield.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLOPA	15-MIN DO	MEDIAN DISS ORTHO P
1703	LAKE BLOOMINGTON	0.050	5.730	464.667	26.200	14.800	0.020
1706	LAKE CARLYLE	0.084	1.270	477.889	17.367	11.000	0.032
1708	LAKE CHARLESTON	0.160	4.680	490.667	12.000	8.400	0.065
1711	COFFEEN LAKE	0.032	0.260	456.222	7.700	14.900	0.012
1712	CRAB ORCHARD LAKE	0.082	0.200	482.222	59.867	13.800	0.013
1714	LAKE DECATUR	0.124	3.750	474.571	43.000	14.500	0.062
1725	LONG LAKE	0.704	1.190	482.667	49.333	8.800	0.398
1726	LAKE LOU YAEGER	0.146	1.600	489.583	10.662	11.400	0.076
1727	LAKE MARIE	0.098	0.370	467.667	39.533	14.700	0.057
1733	PISTAKEE LAKE	0.203	0.370	485.667	75.867	7.000	0.062
1735	RENO LAKE	0.071	0.210	471.500	23.533	12.700	0.012
1739	LAKE SHELBYVILLE	0.062	3.290	461.333	17.161	14.800	0.019
1740	SILVER LAKE (HIGHLAND)	0.226	0.970	489.500	5.822	14.800	0.057
1742	LAKE SPRINGFIELD	0.108	3.265	483.385	13.013	10.800	0.059
1748	VERMILION LAKE	0.109	4.695	481.500	31.150	14.200	0.050
1750	WONDER LAKE	0.426	0.890	486.000	98.533	7.800	0.132
1751	LAKE STORY	0.072	2.510	459.333	17.250	14.800	0.021
1752	DEPUE LAKE	0.438	4.050	490.000	58.833	7.600	0.276
1753	LAKE SANGCHRIS	0.050	1.970	475.417	19.292	14.500	0.009
1754	LAKE HOLIDAY	0.167	3.135	485.167	51.217	7.200	0.046
1755	FOX LAKE	0.214	0.375	486.167	63.850	8.800	0.083
1756	GRASS LAKE	0.301	0.820	481.000	83.580	5.900	0.093
1757	EAST LOON LAKE	0.076	0.120	450.000	22.300	14.900	0.018
1758	SLOCUM LAKE	0.865	0.200	487.333	221.100	5.800	0.362
1759	CEDAR LAKE	0.029	0.170	400.333	5.767	12.800	0.013
1761	LAKE WEMATUK	0.069	1.770	466.333	7.967	14.500	0.031
1762	RACCOON LAKE	0.106	0.310	484.333	19.217	13.800	0.020
1763	BALDWIN LAKE	0.044	0.140	461.167	11.333	13.200	0.007

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	1?-MIN DO	MEDIAN DISS ORTHO P
1764	LAKE VANDALIA	0.116	0.480	478.111	11.276	14.800	0.023
1765	OLD BEN MINE RESERVOIR	0.930	0.205	478.333	31.433	11.200	0.575
1766	HORSESHOE LAKE	0.127	0.705	482.833	182.250	6.800	0.018

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1703	LAKE BLOOMINGTON	88 (26)	0 (0)	80 (24)	47 (14)	13 (2)	68 (20)	296
1706	LAKE CARLYLE	63 (19)	40 (12)	63 (19)	63 (19)	63 (19)	53 (16)	345
1708	LAKE CHARLESTON	37 (11)	7 (2)	0 (0)	77 (23)	77 (23)	27 (8)	225
1711	COFFEEN LAKE	97 (29)	77 (23)	93 (28)	93 (28)	2 (0)	92 (27)	454
1712	CRAB ORCHARD LAKE	67 (20)	90 (27)	43 (13)	20 (6)	42 (12)	85 (25)	347
1714	LAKE DECATUR	40 (12)	13 (4)	53 (16)	33 (10)	30 (8)	32 (9)	201
1725	LONG LAKE	7 (2)	43 (13)	40 (12)	30 (9)	72 (21)	3 (1)	195
1726	LAKE LOU YAEGER	30 (9)	37 (11)	7 (2)	87 (26)	57 (17)	23 (7)	241
1727	LAKE MARIE	60 (18)	68 (20)	73 (22)	37 (11)	23 (7)	42 (12)	303
1733	PISTAKEE LAKE	27 (8)	68 (20)	23 (7)	13 (4)	98 (27)	32 (9)	253
1735	RENO LAKE	77 (23)	80 (24)	70 (21)	50 (15)	53 (16)	92 (27)	422
1739	LAKE SHELBYVILLE	83 (25)	17 (5)	83 (25)	70 (21)	13 (2)	73 (22)	339
1740	SILVER LAKE (HIGHLAND)	20 (6)	47 (14)	10 (3)	97 (29)	13 (2)	42 (12)	229
1742	LAKE SPRINGFIELD	53 (16)	20 (6)	33 (10)	73 (22)	67 (20)	37 (11)	283
1748	VERMILION LAKE	50 (15)	3 (1)	47 (14)	43 (13)	37 (11)	47 (14)	227
1750	WONDER LAKE	13 (4)	50 (15)	20 (6)	7 (2)	80 (24)	13 (4)	183
1751	LAKE STORY	73 (22)	27 (8)	90 (27)	67 (20)	13 (2)	63 (19)	333
1752	DEPUE LAKE	10 (3)	10 (3)	3 (1)	23 (7)	83 (25)	10 (3)	139
1753	LAKE SANGCHRIS	88 (26)	30 (9)	67 (20)	57 (17)	30 (8)	97 (29)	369
1754	LAKE HOLIDAY	33 (10)	23 (7)	27 (8)	27 (8)	87 (26)	50 (15)	247
1755	FOX LAKE	23 (7)	63 (19)	17 (5)	17 (5)	72 (21)	20 (6)	212
1756	GRASS LAKE	17 (5)	53 (16)	50 (15)	10 (3)	97 (29)	17 (5)	244
1757	EAST LOON LAKE	70 (21)	100 (30)	97 (29)	53 (16)	2 (0)	77 (23)	349
1758	SLOCUM LAKE	3 (1)	87 (26)	13 (4)	0 (0)	100 (30)	7 (2)	210
1759	CEDAR LAKE	100 (30)	93 (28)	100 (30)	100 (30)	50 (15)	85 (25)	528
1761	LAKE WEMATUK	80 (24)	33 (10)	77 (23)	90 (27)	30 (8)	57 (17)	367
1762	RACCOON LAKE	57 (17)	73 (22)	30 (9)	60 (18)	42 (12)	68 (20)	330
1763	BALDWIN LAKE	93 (28)	97 (29)	87 (26)	80 (24)	47 (14)	100 (30)	504

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1764	LAKE VANDALIA	47 (14)	60 (18)	60 (18)	83 (25)	13 (2)	60 (18)	323
1765	OLD BEN MINE RESERVOIR	0 (0)	83 (25)	57 (17)	40 (12)	60 (18)	0 (0)	240
1766	HORSESHOE LAKE	43 (13)	57 (17)	37 (11)	3 (1)	93 (28)	80 (24)	313

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1759	CEDAR LAKE	528
2	1763	BALDWIN LAKE	504
3	1711	COFFEEN LAKE	454
4	1735	RENO LAKE	422
5	1757	EAST LOON LAKE	399
6	1753	LAKE SANGCHRIS	369
7	1761	LAKE WENATUK	367
8	1712	CRAB ORCHARD LAKE	347
9	1706	LAKE CARLYLE	345
10	1739	LAKE SHELBYVILLE	339
11	1751	LAKE STORY	333
12	1762	RACCOON LAKE	330
13	1764	LAKE VANDALIA	323
14	1766	HORSESHOE LAKE	313
15	1727	LAKE MARIE	303
16	1703	LAKE BLOOMINGTON	296
17	1742	LAKE SPRINGFIELD	283
18	1733	PISTAKEE LAKE	253
19	1754	LAKE HOLIDAY	247
20	1756	GRASS LAKE	244
21	1726	LAKE LOU YAEGER	241
22	1765	OLD BEN MINE RESERVOIR	240
23	1740	SILVER LAKE (HIGHLAND)	229
24	1748	VERMILION LAKE	227
25	1708	LAKE CHARLESTON	225
26	1755	FOX LAKE	212
27	1758	SLOCUM LAKE	210
28	1714	LAKE DECATUR	201

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
29	1725	LONG LAKE	195
30	1750	WONDER LAKE	183
31	1752	DEPUE LAKE	139

APPENDIX B

CONVERSIONS FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR ILLINOIS 10/23/75

LAKE CODE 1762 HALOON LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 125.9

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1762A1	125.9	0.82	1.23	1.52	1.55	1.23	1.03	0.62	0.32	0.23	0.25	0.37	0.43	0.80
1762A2	40.1	0.38	0.48	1.38	1.11	0.87	0.74	0.44	0.23	0.16	0.17	0.26	0.31	0.57
1762Z1	35.7	0.34	0.35	0.48	0.45	0.35	0.29	0.18	0.09	0.07	0.08	0.11	0.13	0.23

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 125.9 TOTAL FLOW IN = 9.60
SUM OF SUB-DRAINAGE AREAS = 125.9 TOTAL FLOW OUT = 9.60

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1762A1	6	73	1.16	3	0.01				
	7	73	0.01	8	0.01				
	8	73	0.01	5	0.01				
	9	73	0.03	9	0.01				
	11	73	0.99	3	0.01				
	12	73	0.51	2	0.01				
	1	74	0.91	5	0.01				
	2	74	0.85	17	0.01				
	3	74	1.19	3	0.01	16	10.45		
	4	74	1.13	7	0.01				
	5	74	0.16	4	0.01				
1762A2	6	73	1.16	3	0.05				
	7	73	0.07	8	0.0				
	8	73	0.02	5	0.00				
	9	73	0.02	9	0.23				
	10	73	0.03	14	0.11				
	11	73	0.79	3	0.01				
	12	73	2.15	2	0.42				
	1	74	2.10	5	2.52				
	2	74	0.82	17	0.19				
	3	74	0.76	3	1.25	16	1.70		
	4	74	1.42	7	0.82				
	5	74	1.36	4	0.74				
1762Z1	6	73	0.48	3	0.02				
	7	73	0.01	8	0.0				
	8	73	0.01	5	0.0				
	9	73	0.01	9	0.09				
	10	73	0.02	14	0.04				
	11	73	0.28	3	0.01				
	12	73	0.52	2	0.15				
	1	74	0.74	5	0.46				
	2	74	0.30	17	0.05				
	3	74	0.41	3	0.48	16	0.68		
	4	74	0.76	7	0.30				
	5	74	0.54	4	0.28				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/10/23

176201
38 32 40.0 089 06 15.0
RACCOON LAKE
17121 ILLINOIS

11EPALES
3

2111202
0015 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 N02&N03 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/11	13 10	0000	19.2		12	270	7.70	61	0.150	0.800	0.280	0.020
	13 10	0006	19.0	7.9		270	7.70	65	0.210	0.800	0.290	0.024
	13 10	0011	17.5	6.7		260	7.60	64	0.230	1.000	0.290	0.036
73/08/08	10 05	0000	27.9	6.4	30	308	7.80	61	0.140	1.900	0.170	0.012
	10 05	0005	27.8	6.4		308	7.60	60	0.110	1.300	0.110	0.018
	10 05	0010	27.5	1.2		308	7.10	73	0.520	1.800	0.130	0.044
73/10/19	09 43	0000	17.9		18	174	7.40	44	0.140	1.200	0.180	0.016
	09 43	0012	17.9	7.2		174	7.20	44	0.120	0.800	0.160	0.016

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/11	13 10	0000	0.090	3.0
	13 10	0006	0.100	
	13 10	0011	0.106	
73/08/08	10 05	0000	0.062	32.3
	10 05	0005	0.070	
	10 05	0010	0.125	
73/10/19	09 43	0000	0.085	18.1
	09 43	0012	0.073	

STORET RETRIEVAL DATE 75/10/23

176202
38 32 25.0 089 04 30.0
RACCOON LAKE
17121 ILLINOIS

11EPALES
3

2111202
0005 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/11	13 30	0000	19.0	8.1	8	275	7.60	63	0.110	1.000	0.290	0.027
73/08/08	10 30	0000	28.2		12	315	7.50	62	0.120	2.000	0.120	0.024
	10 30	0003	28.3	6.0		318	7.50	62	0.130	1.700	0.140	0.020
73/10/19	09 55	0000	16.8		14	202	7.60	48	0.060	1.000	0.070	0.026
	09 55	0002	16.8	8.4		202	7.50	45	0.080	1.000	0.080	0.018

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/11	13 30	0000	0.110	17.9
73/08/08	10 30	0000	0.145	40.9
	10 30	0003	0.151	
73/10/19	09 55	0000	0.125	3.1
	09 55	0002	0.299	

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/10/23

1762A1
38 32 49.0 089 06 35.0
RACCOON CREEK
17057 7.5 E CENTRALIA
O/RACCOON LAKE
BANK BELO DAM ABOV CONFLU WITH STP EFFLU
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/06/03	10 45		0.190	1.050	0.168	0.034	0.110
73/07/08	08 00		0.315	1.590	0.170	0.058	0.175
73/08/05	17 40		0.072	1.130	0.100	0.036	0.105
73/09/09	07 52		0.069	1.050	0.098	0.038	0.135
73/10/14	09 15		0.150	0.400	0.065	0.016	0.075
73/11/03	09 25		0.110	0.700	0.063		0.230
73/12/02	09 45		0.470	1.300	0.128	0.116	0.260
74/01/06	10 00		0.950	1.200	0.056	0.072	0.200
74/02/17	08 25		0.630	0.700	0.070	0.035	0.115
74/03/03	09 20		0.740	1.300	0.105	0.055	0.290
74/03/16	09 00		0.680	1.500	0.155	0.040	0.125
74/04/07	09 30		0.430	0.800	0.030	0.015	0.040
74/05/04	08 15		0.096	0.700	0.075	0.015	0.070

STORET RETRIEVAL DATE 75/10/23

1762A2
38 31 30.0 089 03 30.0
RACCOON CREEK
17 7.5 E CENTRALIA
I/RACCOON LAKE
ST HWY 161 BRDG 3 MI E OF CENTRALIA
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/06/03	10	10	0.336	2.400	0.120	0.028	0.095
73/07/08	08	50	0.240	2.100	0.132	0.016	0.080
73/08/05	17	20	0.210	1.600	0.370	0.048	0.115
73/09/09	08	00	0.270	9.100	0.650	0.176	0.610
73/11/03	09	35	1.080	1.650	0.072		0.600
73/12/02	09	30	0.460	0.800	0.076	0.032	0.110
74/01/06	09	40	0.600	0.900	0.104	0.016	0.050
74/02/17	08	40	0.102	1.800	0.075	0.020	0.055
74/03/03	09	00	0.630	2.200	0.165	0.035	0.250
74/03/16	09	15	0.528	3.400	0.320	0.070	0.160
74/04/07	09	00	0.148	1.550	0.215	0.020	0.022
74/05/04	08	35	0.200	1.000	0.085	0.030	0.150

STORET RETRIEVAL DATE 75/10/23

1762AA SF1762AA P000065
38 30 56.0 089 02 13.0
RACCOON SCHOOL DISTRICT
17057 7.5 CENTRALIA E
T/RACCOON LAKE
RACCOON CREEK
11EPALES 2141204
4 0000 FEET PTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/09/10	08 30		0.039	11.900	0.132	4.500	5.500	0.003	0.003
73/10/02	10 00		56.000	0.500K	0.050	3.570	5.500	0.002	0.002
73/11/01	09 00		1.372	17.000	2.700	6.400	7.350	0.002	0.002
73/12/05	08 45		12.200	1.700	0.044	3.780	3.800	0.002	0.002
74/01/02	09 00		14.400	5.000	0.040K	2.400	2.800	0.003	0.003
74/02/04	09 00		25.200	9.200	0.055	3.500	5.250	0.003	0.003
74/03/04	09 00		37.000	2.550	0.050	3.900	4.150	0.003	0.003
74/04/09	09 30		24.000	1.000	0.050K	3.600	3.800	0.002	0.002
74/05/01	10 30		38.000	8.200	0.480	3.150	4.900	0.003	0.003
74/06/04	09 30		73.000	3.300	0.050K	5.250	5.300	0.003	0.003

K VALUE KNOWN TO BE
LESS THAN INDICATED